

CLAIMS

1. A magneto-resistive element comprising:

a substrate;

5 a metal artificial lattice film in which a magnetic thin film and a non-magnetic metal thin film are alternately laminated in at least two layers on a part of this substrate and formed into a predetermined pattern;

a first protective layer covering the metal artificial lattice
10 film on the substrate; and

a second protective layer formed on the first protective layer;

wherein residual stress of the first protective layer is substantially zero, and the second protective layer is made of a
15 material rejecting water.

2. The magneto-resistive element of claim 1, wherein the magnetic thin film is made of an alloy containing nickel (Ni), iron (Fe) and cobalt (Co), and the non-magnetic metal thin film is made of one
20 of copper (Cu) and silver (Ag).

3. A magneto-resistive element comprising:

a substrate;

a metal artificial lattice film in which a magnetic thin
25 film and a non-magnetic metal thin film are laminated in at least two layers on a part of this substrate and formed into a predetermined pattern; and

a protective layer covering the metal artificial lattice film

on the substrate;

wherein the magnetic thin film contains nickel (Ni), iron (Fe), and cobalt (Co), and in percentage composition based on the number of atoms, nickel (Ni) ranges from 1 to 5 atomic%, cobalt (Co) ranges from
5 50 to 95 atomic %, and a residue is iron.

4. The magneto-resistive element of claim 3, wherein the magnetic thin film is an alloy film having a composition ratio based on the number of atoms of nickel (Ni): cobalt (Co): iron (Fe) = 4: 90: 6.

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5. The magneto-resistive element of claim 3 or 4, wherein the non-magnetic metal thin film is made of one of copper (Cu) and silver (Ag).

15 6. The magneto-resistive element of any one of claims 3 through 5, wherein the protective layer comprises a first protective layer formed on the substrate including the metal artificial lattice film, and a second protective layer formed on the first protective layer, residual stress of the first protective layer is substantially zero, and the second
20 protective layer is made of a material rejecting water.

7. The magneto-resistive element of claim 1 or 6, wherein the first protective layer is made of one of silicon monoxide (SiO), silicon dioxide (SiO₂), silicon nitride (SiN_x), and silicon oxynitride (SiON),
25 and the second protective layer is made of polyimide.

8. The magneto-resistive element of any one of claims 1 through 4, wherein magnetic strain of the magnetic thin film is zero.

9. The magneto-resistive element of claim 1 or 3, wherein the substrate is made of ceramics.

5 10. The magneto-resistive element of claim 9, wherein the substrate is a glazed ceramic substrate having a glass glazed thereon, and the metal artificial lattice film is formed on the glass layer.

11. The magneto-resistive element of claim 10, wherein an
10 amount of sodium ions (Na^+), potassium ions (K^+), and chlorine ions (Cl^-) contained in the glass layer is up to 10 ppm each.

12. The magneto-resistive element of claim 1, 6, or 7, wherein
an amount of sodium ions (Na^+), potassium ions (K^+), and chlorine ions
15 (Cl^-) contained in the first protective layer is up to 10 ppm each.

13. A method of manufacturing a magneto-resistive element comprising the steps of:

forming a metal artificial lattice film having a
20 predetermined pattern in which a magnetic thin film and a non-magnetic metal thin film are alternately laminated in at least two layers on a part of a substrate;

forming a first protective layer covering the artificial
lattice film on the substrate and having a residual stress of
25 substantially zero; and

forming a water-rejecting second protective layer on the first protective layer.

14. The method of manufacturing a magneto-resistive element of claim 13, wherein the metal artificial lattice film is made of alternately laminating the magnetic thin film and the non-magnetic metal thin film, the magnetic thin film is an alloy made of nickel (Ni), cobalt (Co), and iron (Fe), in percentage composition based on the number of atoms, nickel (Ni) ranges from 1 to 5 atomic%, cobalt (Co) ranges from 50 to 95 atomic %, and a residue is iron, and the non-magnetic metal film is made of one of copper (Cu) and silver (Ag).

15 15. The method of manufacturing a magneto-resistive element of claim 13, wherein the step of forming the first protective layer includes forming one of silicon monoxide (SiO), silicon dioxide (SiO₂), silicon nitride (SiN_x), and silicon oxynitride (SiON) by one of sputtering and physical vapor deposition processes with a temperature of the substrate set in a range of 200 to 250°C.

16. The magneto-resistive element of claim 1 or 3, wherein the magneto-resistive element is used in an environment of at least 150°C.

20 17. A method of using a magneto-resistive element, wherein the magneto-resistive element of claim 1 or 6 is used in an environment of at least 150°C.